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(12) **Patent Application:**

(11) **CA 2197485**

(54) **WET-RESILIENT WEBS AND DISPOSABLE ARTICLES MADE THEREWITH**

(54) **FEUILLES DOTEES DE RESILIENCE A L'ETAT HUMIDE ET ARTICLES JETABLES QU'ON EN FAIT**

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**ABSTRACT:**

Paper sheets useful for tissues, paper towels, napkins, disposable absorbent products and the like can be made to exhibit a high degree of wet resiliency. This property is achieved by using a combination of high yield pulp fibers (such as bleached chemithermomechanical pulp fibers) and a wet strength agent in an uncreped throughdrying process. The resulting product, when wetted, can spring back after being crumpled in one's hand.

Abstract of the Disclosure

Paper sheets useful for tissues, paper towels, napkins, disposable absorbent products and the like can be made to exhibit a high degree of wet resiliency. This property is achieved by using a combination of high yield pulp fibers (such as bleached  
5 chemithermomechanical pulp fibers) and a wet strength agent in an uncreped throughdrying process. The resulting product, when wetted, can spring back after being crumpled in one's hand.

We claim:

1. A low-density, noncompressively-dried, three-dimensional web comprising at least about 15 dry weight percent high yield pulp fibers to which a wet strength agent has been added, said web having a density of about 0.3 grams per cubic centimeter or less, an Overall Surface Depth of about 0.2 millimeter or greater, an In-Plane Permeability of about  $5 \times 10^{-11}$  square meters or greater and a Wet Compressed Bulk of about 6 cubic centimeters per gram or greater.
2. An uncreped through-air-dried web comprising at least about 10 dry weight percent virgin high yield pulp fibers to which a wet strength agent has been added, said web having a density of about 0.15 gram per cubic centimeter or less, a Wet Compressed Bulk of about 6 cubic centimeters per gram or greater and an Overall Surface Depth of about 0.3 millimeter or greater.
3. A cellulosic web having a density of about 0.3 gram per cubic centimeter or less, a wet:dry ratio of about 0.10 or greater, an Overall Surface Depth of about 0.2 millimeter or greater, and a Wet Compressed Bulk of about 7 cubic centimeters per gram or greater.
4. The web of Claim 1 or 2 comprising at least about 30 dry weight percent high yield pulp fibers.
5. The web of Claim 1 or 2 comprising at least about 50 dry weight percent high yield pulp fibers.
6. The web of Claim 1 or 2 comprising about 100 dry weight percent high yield pulp fibers.
7. The web of Claim 1 or 2 wherein the high yield pulp fibers are bleached chemithermomechanical pulp fibers.

8. The web of Claim 1 or 2 comprising at least about 70 dry weight percent wood pulp fibers.
9. The web of Claim 1 or 2 comprising at least about 70 dry weight percent softwood fibers.
10. The web of Claim 1 or 2 wherein at least about 0.2 dry weight percent of a wet strength agent has been added.
11. The web of Claim 1 or 2 wherein from about 0.1 to about 3 dry weight percent of a wet strength agent has been added.
12. The web of Claim 1 or 2 or 3 having a basis weight of from about 10 to about 80 grams per square meter.
13. The web of Claim 1 or 2 or 3 having a basis weight of from about 20 to about 60 grams per square meter.
14. The web of Claim 1 or 2 or 3 having a density of about 0.1 gram per cubic centimeter or less.
15. The web of Claim 1 or 2 or 3 having a Wet Wrinkle Recovery of about 60 percent or greater.
16. The web of Claim 1 or 2 or 3 having a Wet Wrinkle Recovery of about 70 percent or greater.
17. The web of Claim 1 or 2 or 3 having a Wet Wrinkle Recovery of about 80 percent or greater.
18. The web of Claim 1 or 2 or 3 having a wet:dry ratio of about 0.2 or greater.
19. The web of Claim 1 or 2 or 3 having a wet:dry ratio of about 0.5 or greater.

20. The web of Claim 1 or 2 or 3 having a Compression Ratio of from 0.4 to about 0.7.
21. The web of Claim 1 or 2 or 3 having a Wet Springback Ratio of about 0.75 or greater.
22. The web of Claim 1 or 2 or 3 having a Wet Springback Ratio of about 0.9 or greater.
23. The web of Claim 1 or 2 or 3 having a Wet Springback Ratio of from about 0.8 to about 0.93.
24. The web of Claim 1 or 2 or 3 having a Loading Energy Ratio of about 0.7 or greater.
25. The web of Claim 1 or 2 or 3 having a Loading Energy Ratio of about 0.8 or greater.
26. The web of Claim 1 or 2 or 3 having a Loading Energy Ratio of from about 0.7 to about 0.9.
27. The web of Claim 1 or 2 or 3 having a Wet Compressed Bulk of about 7 cubic centimeters per gram or greater.
28. The web of Claim 1 or 2 or 3 having a Wet Compressed Bulk of about 8 cubic centimeters per gram or greater.
29. The web of Claim 1 or 2 or 3 having a Wet Compressed Bulk of from about 8 to about 13 cubic centimeters.
30. The web of Claim 1 or 2 or 3 having a Wet Compressed Bulk of about 8 cubic centimeters per gram or greater, a Wet Springback ratio of about 0.8 or greater and a Loading Energy Ratio of about 0.7 or greater.

31. The web of Claim 1 or 2 or 3 wherein the fibers of the web have a water retention value of about 0.9 or greater.
32. The web of Claim 1 or 2 or 3 having an In-Plane Permeability of about  $5 \times 10^{-11}$  square meters or greater.
33. The web of Claim 1 or 2 or 3 having an In-Plane Permeability of from about  $5 \times 10^{-11}$  to about  $80 \times 10^{-11}$  square meters.
34. The web of Claim 1 or 2 or 3 having an In-Plane Permeability of from about  $8 \times 10^{-11}$  to about  $30 \times 10^{-11}$  square meters.
35. The web of Claim 1 or 2 or 3 having a FIFE Test value of about 125 seconds or less.
36. The web of Claim 1 or 2 or 3 having a FIFE Test value of about 75 seconds or less.
37. The web of Claim 1 or 2 or 3 having a Dry Wipe Residue Total Area coverage of about 2000 square millimeters or less.
38. The web of Claim 1 or 2 or 3 having a Dry Wipe Residue Mass Factor of about 30 or less.
39. The web of Claim 1 or 2 or 3 having a Wet Wipe Residue Total Area coverage of about 1500 square millimeters or less.
40. The web of Claim 1 or 2 or 3 having a Wet Wipe Residue Mass Factor of about 5 or less.
41. The web of Claim 1 or 2 or 3 having a Mean Volume-Weighted Pore Length of about 550 microns or greater.
42. The web of Claim 1 or 2 or 3 having a Thickness Variation Index of about 25 percent or less.

43. The web of Claim 1 or 2 or 3 having an Overall Surface Depth of from about 0.4 to about 0.8 millimeters.
44. The web of Claim 1 which has been through-air-dried.
45. An absorbent article comprising the web of Claim 1 or 2 or 3.
46. A disposable diaper comprising the web of Claim 1 or 2 or 3.
47. A feminine pad comprising the web of Claim 1 or 2 or 3.
48. A meat and poultry pad comprising the web of Claim 1 or 2 or 3.
49. A bed pad comprising the web of Claim 1 or 2 or 3.
50. An absorbent article comprising a backsheet layer, a liquid permeable topsheet layer connected in a superposed relation with said backsheet layer, and at least one through-air-dried sheet sandwiched between said topsheet layer and backsheet layer, said through-air-dried sheet comprising at least about 20 dry weight percent high yield pulp fibers to which a wet strength agent has been added and having a density of about 0.3 grams per cubic centimeter or less, an Overall Surface Depth of about 0.3 millimeters or greater and a Wet Compressed Bulk of about 7 cubic centimeters per gram or greater.
51. The absorbent article of Claim 50 wherein the through-air-dried sheet has a Wet Compressed Bulk of about 7 cubic centimeters per gram or greater.
52. The absorbent article of Claim 50 wherein the through-air-dried sheet has a FIFE Test value of about 125 seconds or less.
53. The absorbent article of Claim 50 wherein the through-air-dried sheet has an In-Plane Permeability of about  $4 \times 10^{-11}$  or greater.



54. The absorbent article of Claim 50 further comprising an absorbent fluff batt of fibers adjacent the through-air-dried sheet.
55. The absorbent article of Claim 50 having from 2 to about 20 through-air-dried sheets.
56. The absorbent article of Claim 50 wherein the through-air-dried sheet is uncreped.
57. An absorbent article comprising a cellulosic web having a density of about 0.3 gram per cubic centimeter or less, a wet:dry ratio of about 0.1 or greater, an Overall Surface Depth of about 0.2 millimeter or greater, a Wet Compressed Bulk of 7 cubic centimeters per gram or greater, a Wet Springback Ratio of about 0.75 or greater, a FIFE Test value of 125 seconds or less, and an In-Plane Permeability of about  $4 \times 10^{-11}$  square meters or greater.
58. An absorbent article comprising a backsheet layer, a liquid permeable topsheet layer connected in a superposed relation with said backsheet layer, and a retention portion for storing liquid, said retention portion sandwiched between said topsheet layer and backsheet layer and including at least one uncreped through-air-dried sheet having a density of about 0.3 grams per cubic centimeter or less, a FIFE Test value of about 100 seconds or less, and an Overall Surface Depth of about 0.3 millimeter or greater, said sheet comprising at least about 20 dry weight percent high yield pulp fibers to which a wet strength agent has been added.
59. The absorbent article of Claim 58 wherein said retention portion comprises a pair of said uncreped through-air-dried sheets with high absorbency materials disposed between said sheets.
60. The absorbent article of Claim 59 further comprising a liquid acquisition/distribution layer disposed between said topsheet layer and said sheets and a support layer disposed between said sheets and said backsheet layer.
61. The absorbent article of Claim 60 wherein said support layer comprises a compressed layer of wood pulp fluff.

- 5
62. The absorbent article of Claim 58 wherein said sheet is folded to form an envelope and high-absorbency materials are disposed within said envelope.
63. The absorbent article of Claim 58 wherein said sheet has a Wet Compressed Bulk of about 8 cubic centimeters per gram.
64. An absorbent article comprising a backsheet layer, a liquid permeable topsheet layer connected in a superposed relation with said backsheet layer, and an absorbent structure sandwiched between said topsheet layer and backsheet layer, said absorbent structure including a retention portion for storing said liquid, and a surge portion for managing a distribution of said liquid, said surge portion including at least one uncreped through-air-dried sheet having a density of about 0.3 grams per cubic centimeter or less, an Overall Surface Depth of about 0.3 millimeters or greater, and an In-Plane Permeability of about  $5 \times 10^{-11}$  square meters or greater.
65. An article as recited in Claim 64, wherein said surge portion manages a distribution of said liquid.
66. An article as recited in Claim 64, wherein said surge portion manages an acquisition of said liquid.

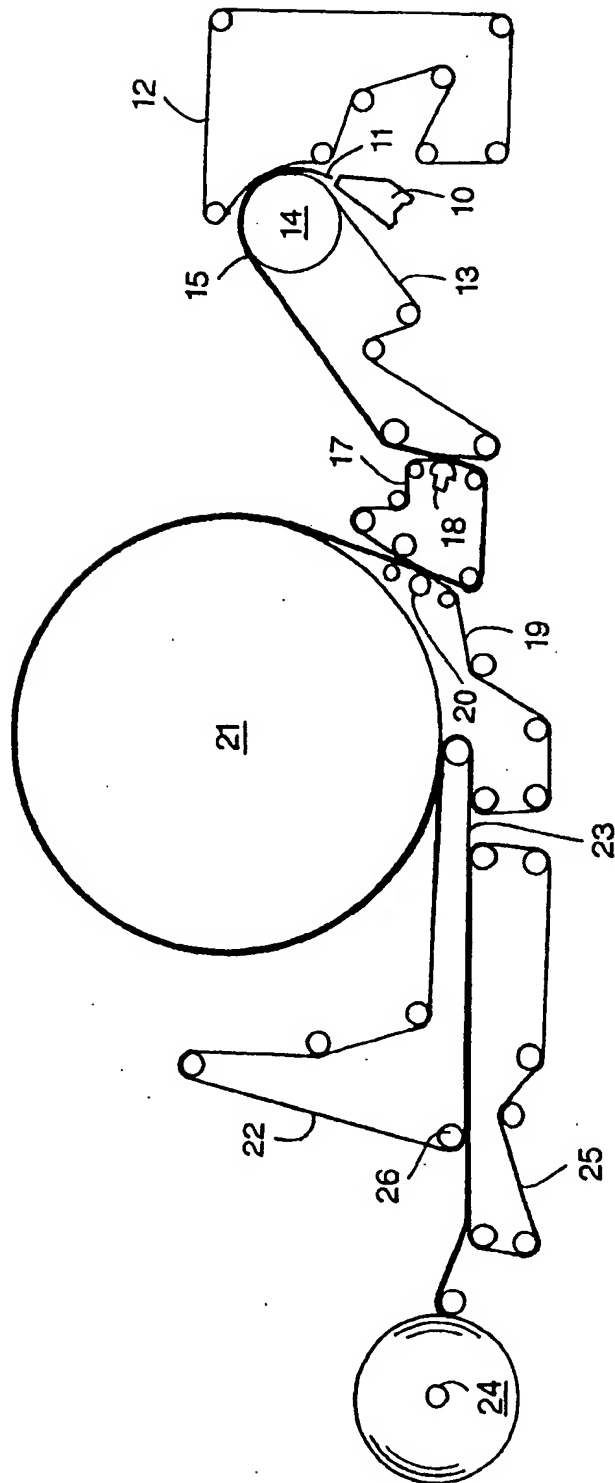
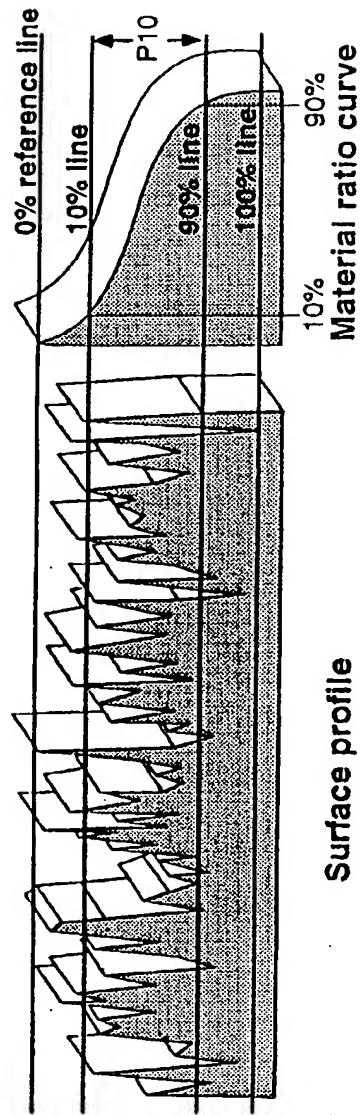


FIG. 1

**FIG. 2**

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Del z: 0.304 mm

**FIG. 3A**



Del z: 0.134 mm

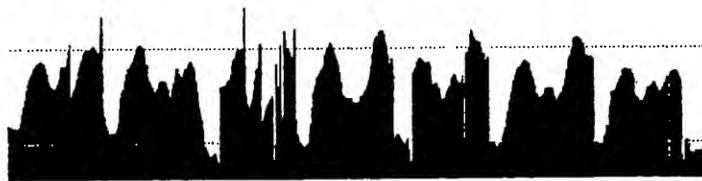
**FIG. 3B**

P10: 0.233 mm



**FIG. 3C**

P10: 0.419 mm

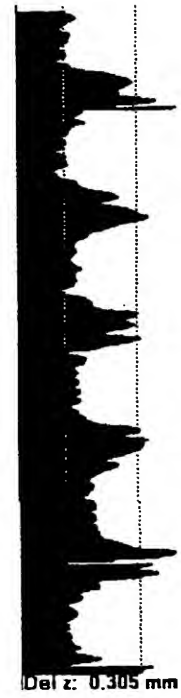


**FIG. 4A**



Del z: 0.300 mm

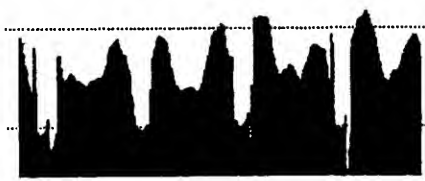
**FIG. 4B**



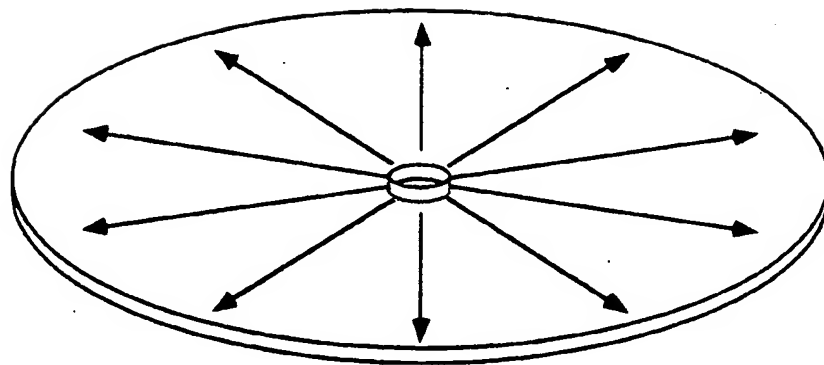
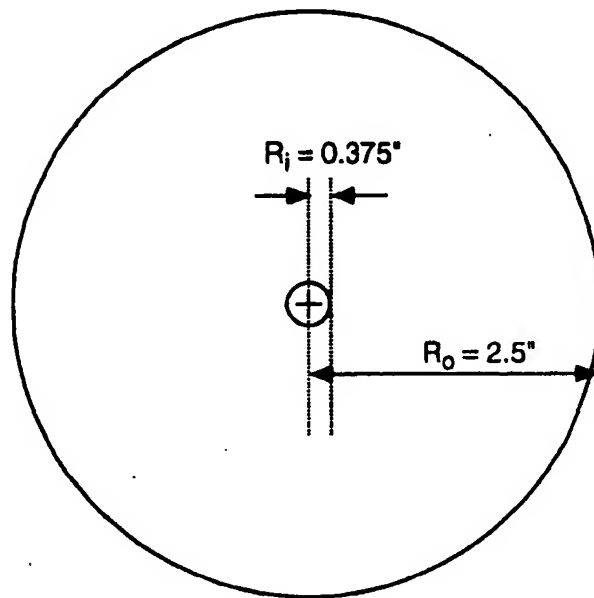
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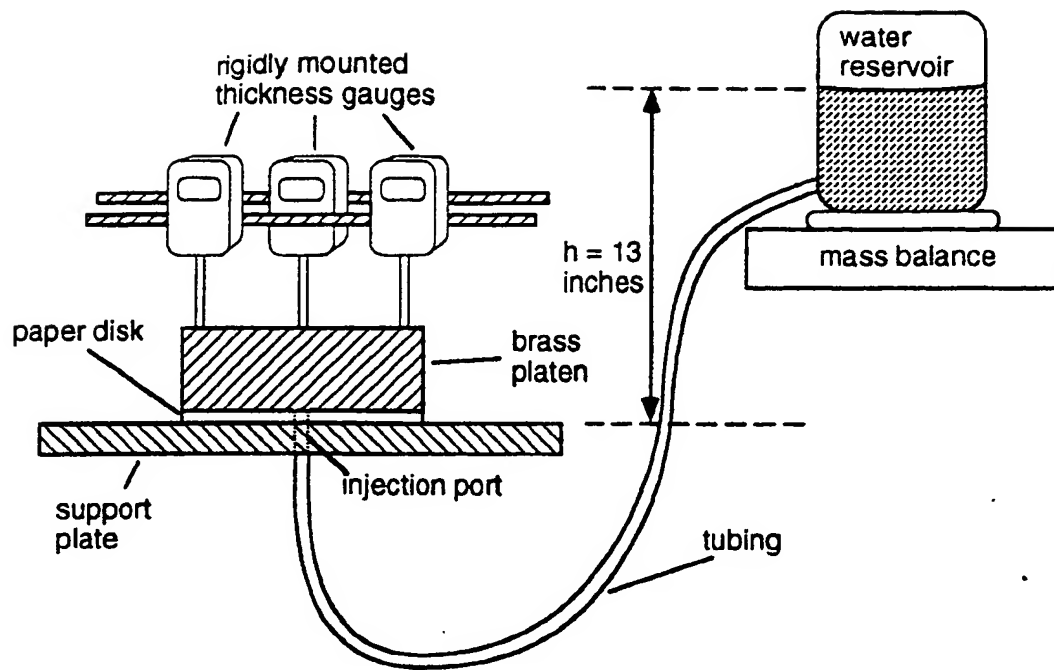
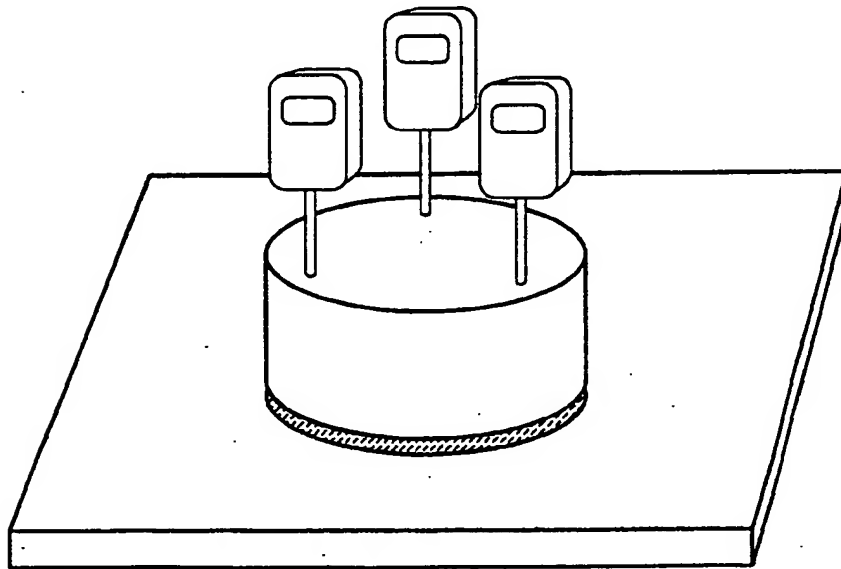
**FIG. 4C**

P10: 0.509 mm



**FIG. 5**

**FIG. 6****FIG. 7**

**FIG. 8****FIG. 9**



Present invention sample numbers	Fiber	BW (single ply)	Kymene, lb/ton of fiber	Fabric type	Rush transfer, %
U1	Spruce BCTMP	30	20	T116-3	15
U2	Spruce BCTMP	60	20	T116-3	30
U3	Spruce BCTMP	40	10	T 116-3	35
U4	Spruce BCTMP	40	20	T 116-3	35
U5	Spruce BCTMP	60	10	T 116-3	35
U6	Spruce BCTMP	60	20	T 116-3	35
U7	Spruce BCTMP	60	10	T 116-3	15
U8	25% Spruce BCTMP, 75% north. SW kraft	60	10	T 116-3	15
U9	Spruce BCTMP	60	10	T 116-1	15
U10	Spruce BCTMP	40	30	T 116-3	?

**FIG. 10**

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Related Art Materials	BW, gsm	Sheets	MR	Initial bulk, cc/g	Comp. bulk, cc/g	Final bulk, cc/g	Spring-back	LER
Viva Ultra	62	2	1.00	13.0	4.3	6.7	0.515	0.475
Brawny, 1994	47	3	1.26	12.2	3.7	7.5	0.614	0.635
Bounty Quilted	38	2	1.25	21.4	5.8	14.1	0.657	0.623
Bounty Quilted	39	3	1.18	20.7	5.6	13.8	0.667	0.626
Printed Bounty	60	2	1.09	21.6	5.5	13.0	0.604	0.604
Air-laid Softwood	129	1	0.93	27.5	6.3	11.5	0.417	0.494
<b>Other Uncreped Materials</b>								
Surpass	41	3	1.27	11.6	5.2	9.2	0.793	0.720
Surpass	40	3	1.08	12.0	5.3	9.6	0.797	0.673
Surpass	41	3	1.13	11.5	5.2	9.1	0.793	0.720
O2	38	3	1.22	13.5	5.8	10.3	0.762	0.623
O3	60	2	1.12	12.9	6.8	10.6	0.825	0.658
O4	59	2	1.09	10.2	5.2	8.1	0.796	0.664
<b>Present Invention</b>								
U2	57	2	1.21	15.2	8.7	14.1	0.929	0.835
U3	39	3	1.58	23.1	9.6	18.3	0.793	0.713
U3	40	3	1.18	22.6	9.7	18.0	0.798	0.716
U4	40	3	1.33	21.8	9.7	18.0	0.829	0.740
U5	55	2	1.16	16.7	9.4	14.7	0.880	0.807
U5	58	2	1.18	15.3	9.2	13.8	0.903	0.793
U6	58	2	1.24	16.2	9.7	14.3	0.883	0.814
U6	58	2	1.34	16.3	9.6	14.5	0.895	0.833
U7	59	2	1.08	14.9	8.3	12.8	0.861	0.797
U7	58	2	1.19	16.0	8.0	13.5	0.842	0.768
U8	58	2	1.16	13.2	7.5	11.1	0.839	0.718
U9	59	2	1.12	13.1	7.3	11.7	0.889	0.761
U10	37	3	1.16	24.2	11.6	20.2	0.835	0.755
U10	38	3	1.22	23.6	10.9	19.1	0.809	0.735

FIG. 11

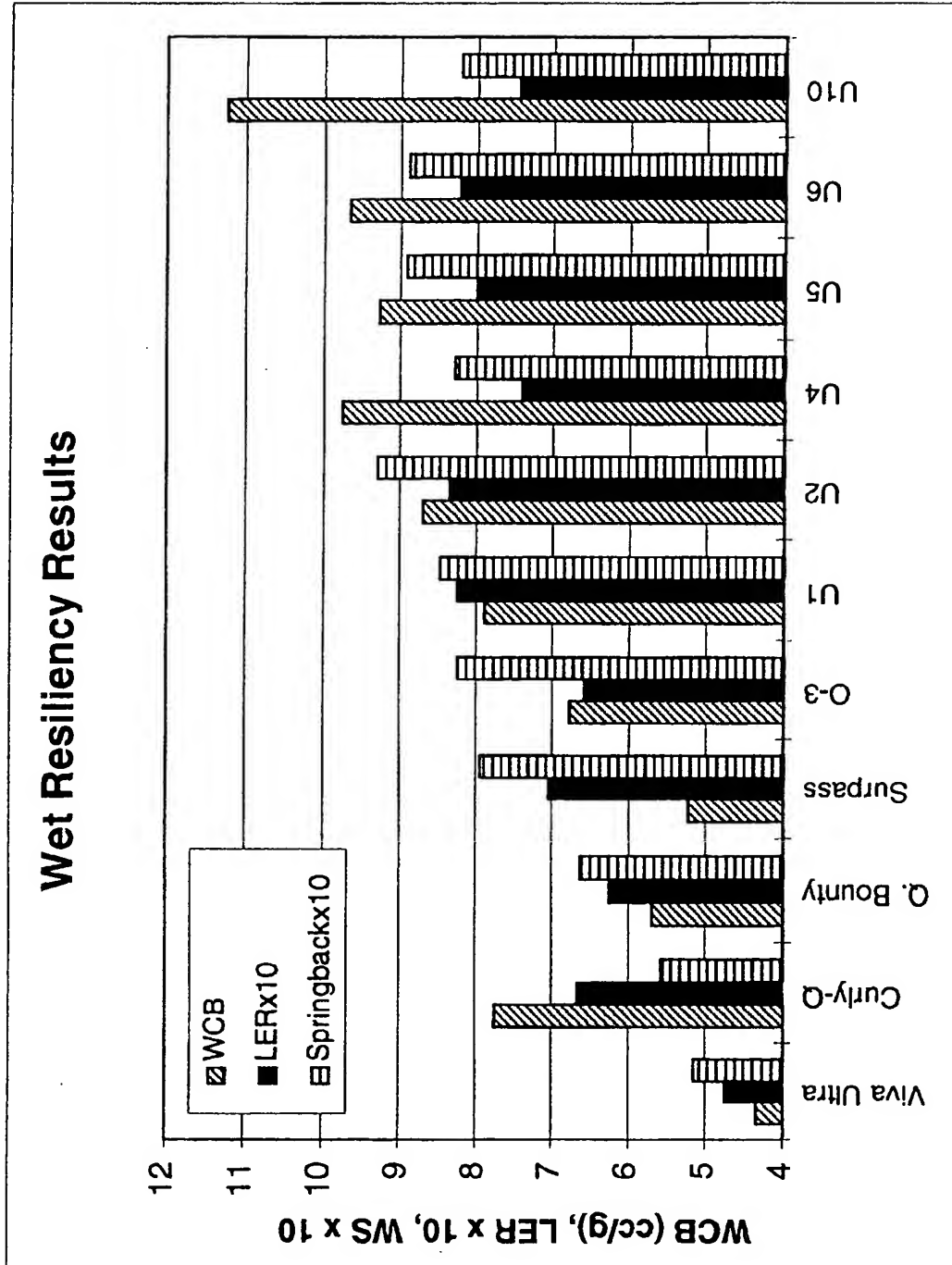


FIG. 12

Sample	Dry BW, gsm	Wet weight, g	Oven dry weight, g	Moisture ratio	Initial thickness @ 0.025 psi	Thickness at 2 psi, in	Final thickness, in	Initial bulk, cc/g	Wet Comp. Bulk, cc/g	Final bulk, cc/g	Spring-back	LER
CQ-A	155	1.34	0.644	1.08	0.226	0.051	0.115	35.9	8.11	18.3	0.509	0.64
CQ-A2	153	1.39	0.637	1.18	0.176	0.046	0.109	28.3	7.40	17.5	0.619	0.723
CQ-A3	150	1.24	0.625	0.98	0.159	0.043	0.099	26.1	7.05	16.2	0.623	0.736
CQ-B	107	1.02	0.445	1.29	0.15	0.036	0.081	34.5	8.29	18.6	0.54	0.641
CQ-C	184	1.565	0.766	1.04	0.277	0.059	0.140	37.0	7.89	18.7	0.505	0.634
CQ-D	214	1.98	0.891	1.22	0.342	0.067	0.174	39.3	7.70	20.0	0.509	0.599
CQ-E	201	1.82	0.835	1.18	0.285	0.064	0.146	35.0	7.85	17.9	0.512	0.636
CQ-F	87	0.741	0.361	1.05	0.101	0.027	0.065	28.7	7.66	18.5	0.644	0.713
HBAFF-1	121	1.057	0.502	1.11	0.168	0.033	0.073	34.3	6.73	14.9	0.435	0.566
HBAFF-2	94	0.866	0.392	1.21	0.141	0.025	0.062	36.8	6.53	16.2	0.44	0.599
HPZ	95	0.853	0.397	1.15	0.113	0.022	0.052	29.2	5.68	13.4	0.46	0.565

FIG. 13

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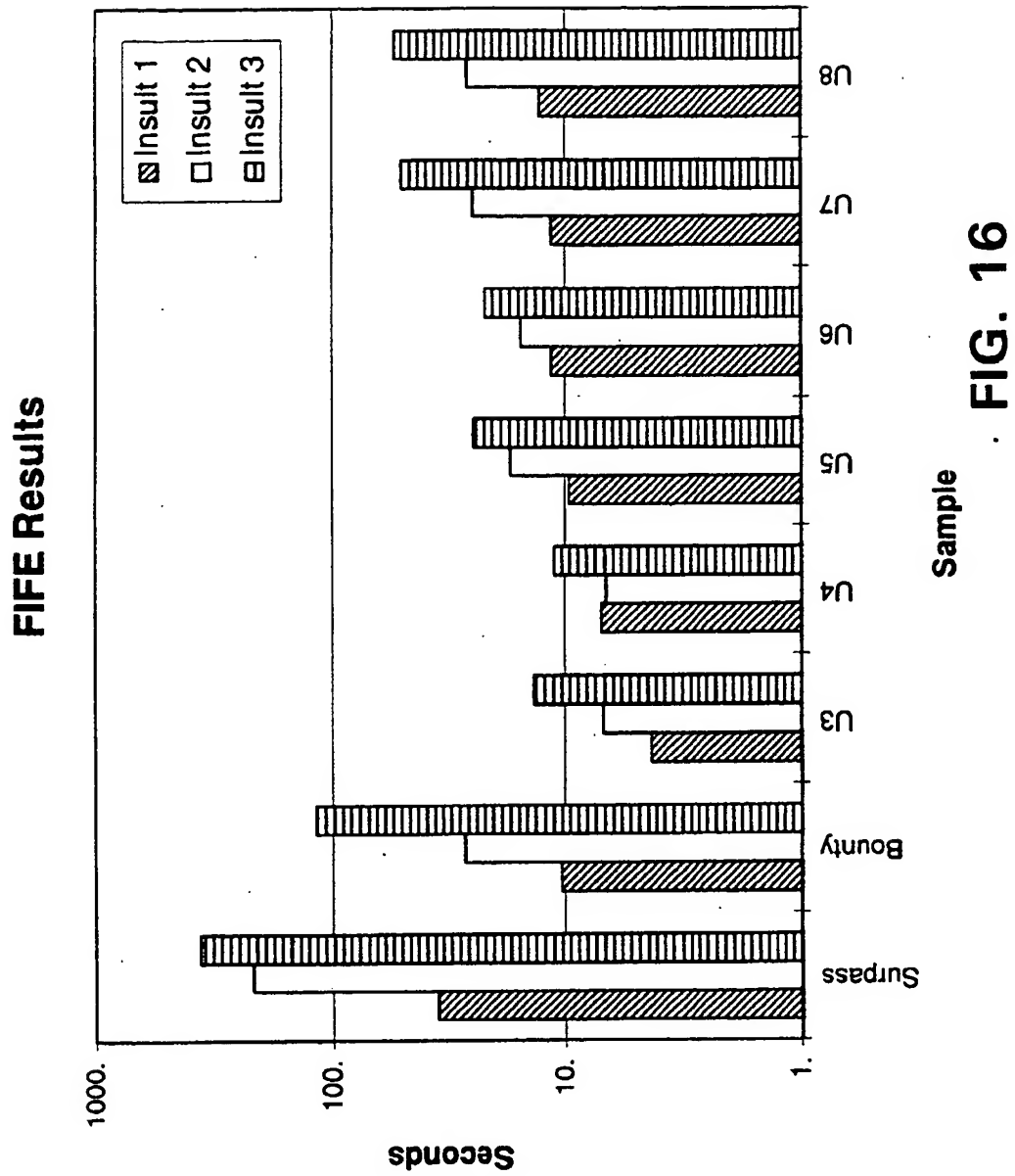
Present invention sample numbers	Fiber	BW (single ply)	Sheets or layers used	Kymene, lb/ton of fiber	Fabric type	Rush transfer, %	In-plane permeab., $m^2 \times 10^{10}$	Wet bulk at 0.8 psi, cc/g
U3	Spruce BCTMP	40	2	10	T 116-3	35	1.05	10.31
U4	Spruce BCTMP	40	2	20	T 116-3	35	1.19	10.99
U4b	Spruce BCTMP	40	2	20	T 116-3	35	1.56	11.79
U4c	Spruce BCTMP	40	3	20	T 116-3	35	1.22	11.46
U4d	Spruce BCTMP	40	4	20	T 116-3	35	1.05	11.20
U5	Spruce BCTMP	60	2	10	T 116-3	35	1.26	9.89
U6	Spruce BCTMP	60	2	20	T 116-3	35	1.87	10.53
U7	Spruce BCTMP	60	2	10	T 116-3	15	0.55	8.46
U8	25% Spruce BCTMP, 75% north. SW kraft	60	2	10	T 116-3	15	0.84	7.99
U9	Spruce BCTMP	60	2	10	T 116-1	15	0.60	7.74
Other samples								
P1	Surpass towel	40	2				0.41	5.43
P2	Quilted Bounty	40	2				0.34	5.70
P3	HBAFF air-laid pad	229	1				0.30	7.71
P4	Curly-Q fiber, air-laid	245	1				0.43	8.87
P5	Birch BCTMP UCTAD	60	1	0			0.05	5.79
P6	Untreated softwood fluff	179	2				0.03	6.59
P7	Air-laid CR-1654	206	1				0.043	6.74

FIG. 14

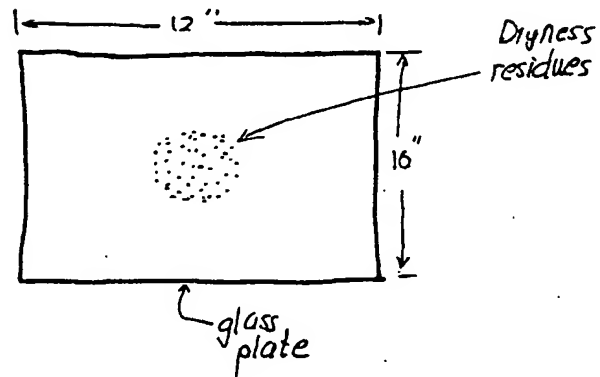
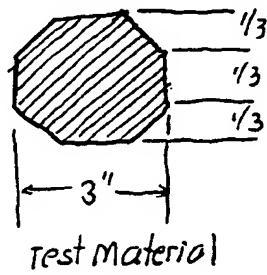
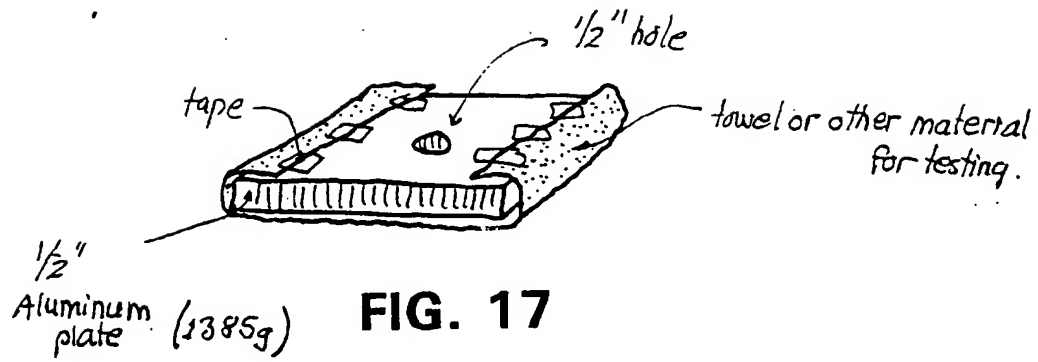
Code	Insult 1 time, sec	Insult 2 time, sec	Insult 3 time, sec	Sum of insult times	Dry weight
Surpass	35.	215.9	358.1	609.	9.3
Bounty	10.3	26.8	117.4	155.	8.83
U3	4.3	6.9	13.5	25.	10.77
U4	7.0	6.7	11.2	25.	10.46
U5	9.5	16.9	24.5	51.	10.45
U6	11.4	15.3	21.8	49.	10.62
U7	11.4	24.7	50.4	86.	10.72
U8	12.7	26.1	53.7	92.	10.24

FIG. 15

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Dry Wipe Residual Data

Sample Identification	Total Area (mm <sup>2</sup> )	% Coverage	Mass Factor (area*darkness/1000)
1. Surpass	3222	29.0	58.0
2. BOUNTY®	3684	53.4	57.0
3. CHF, 40 gsm, 10 lb/t	1421	16.6	17.5
4. " " " , 20 "	971	12.9	11.0
5. " , 60 " , 10 "	1002	15.1	9.7
6. " , " " , 20 "	780	12.2	8.3
7. EFU, " " , 10 "	892	11.0	7.5
8. CHF, " " , 25/75, Spr./LL19, 10 lb/t	708	10.3	11.0

FIG. 20

Wet Wipe Residual Data

Sample Identification	Total Area (mm <sup>2</sup> )	% Coverage	Mass Factor (area*darkness/1000)
1. Surpass	1086	22.0	8.87
2. BOUNTY®	1815	35.4	16.4
3. CHF, 40 gsm, 10 lb/t	581	12.2	4.06
4. " " " , 20 "	652	13.6	5.00
5. " , 60 " , 10 "	419	8.72	2.76
6. " " " , 20 "	476	10.3	3.46
7. EFU, " " , 10 "	657	13.6	3.28
8. CHF, " " , 25/75, Spr./LL19, 10 lb/t	576	11.8	4.16

FIG. 21

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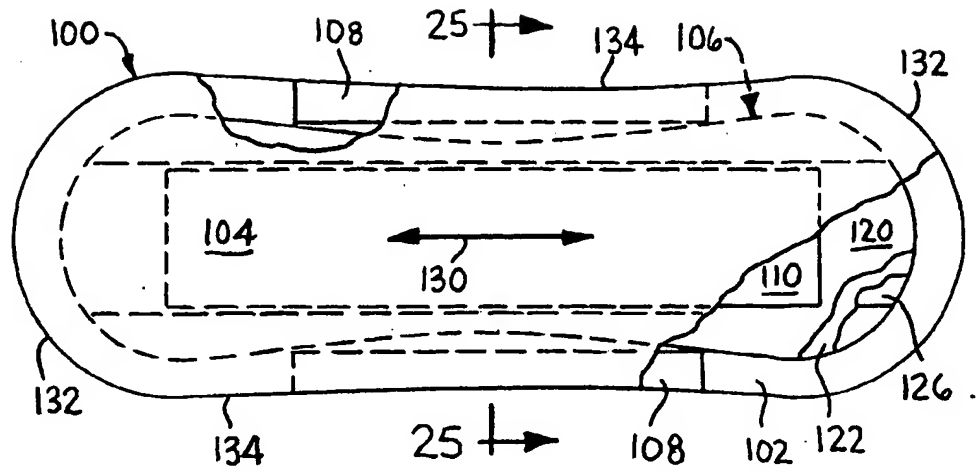
Sample Identification	Mean Volume-Weighted Pore Length	Thickness Variation (% COV)
1. Surpass	136	14.9
2. BOUNTY®	484	43.9
3. CHF, 40 gsm, 10 lb/t	642	8.7
4. " " " 20 "	930	17.8
5. " " " 60 " 10 "	788	15.0
6. " " " 20 "	849	—
7. EFU, " " 10 "	772	—
8. CHF, " " 25/75, Spr./LL19, 10 lb/t	697	16.8

FIG. 22

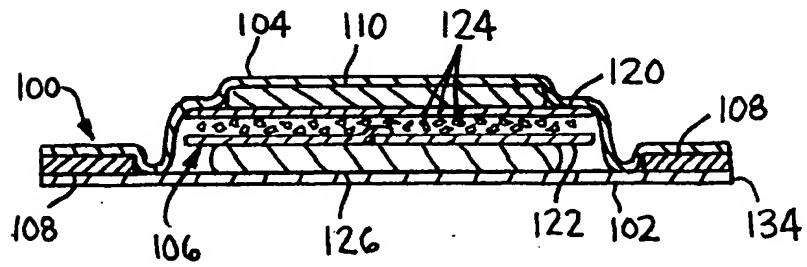


A typical photo

FIG. 23

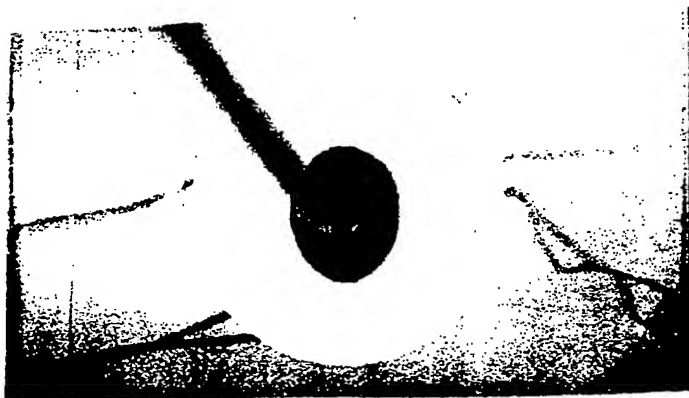


**FIG. 24**

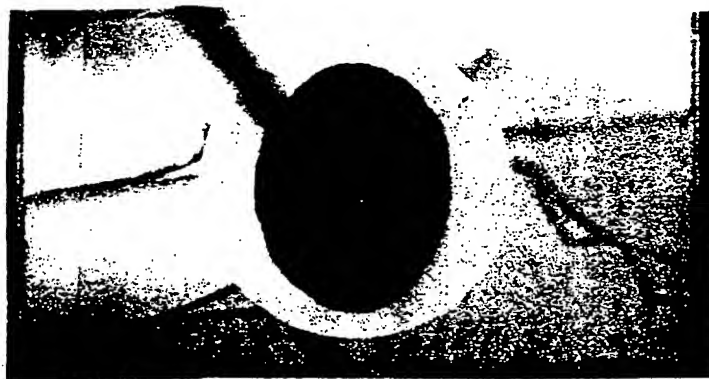


**FIG. 25**

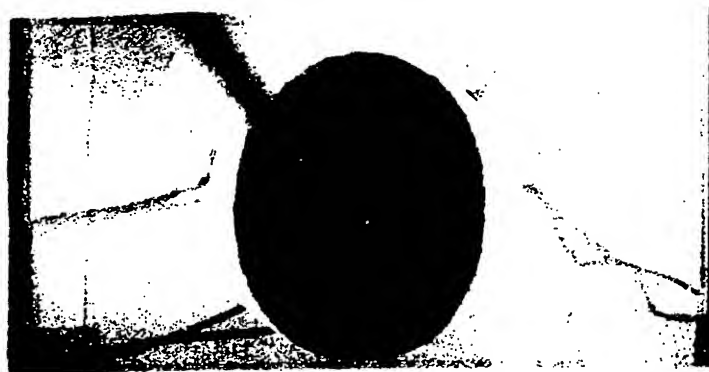
2197485



**FIG. 26A**

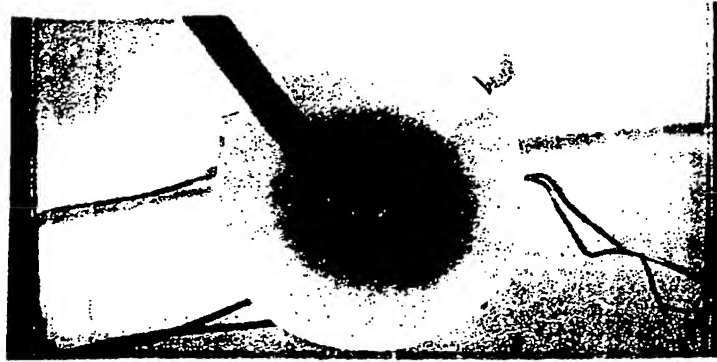


**FIG. 26B**



**FIG. 26C**

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**FIG. 27**

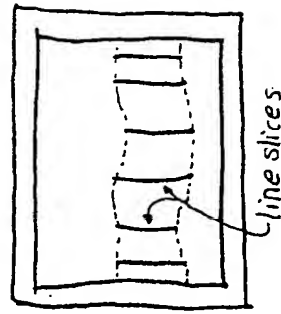


FIG. 28C

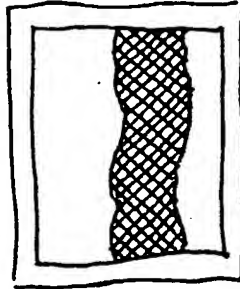


FIG. 28B

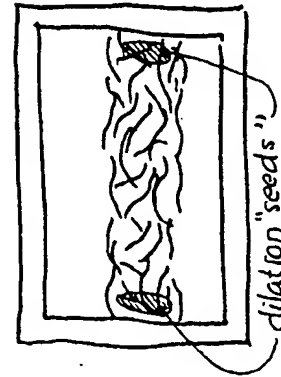


FIG. 28A